

Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884



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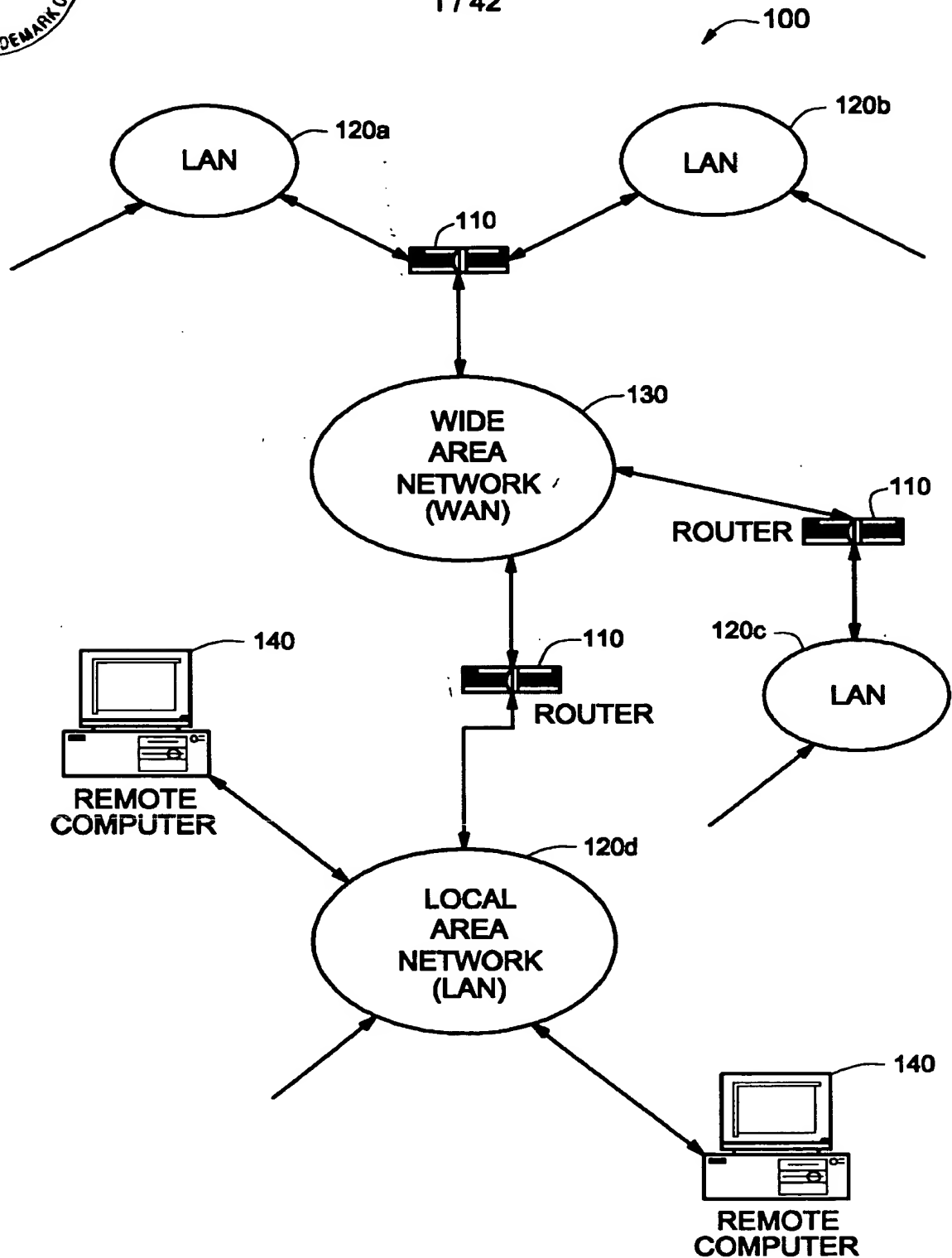


Figure 1



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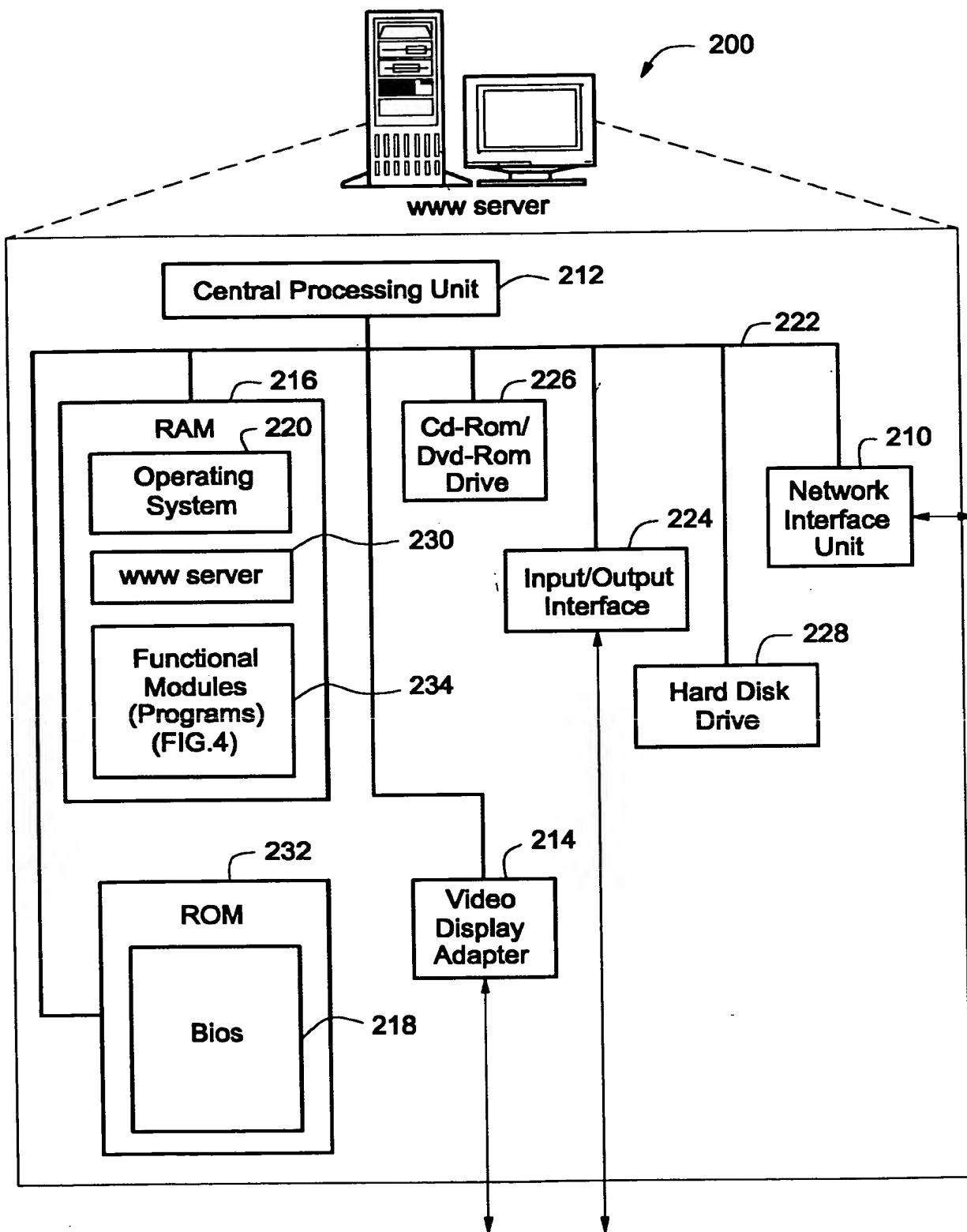


Figure 2



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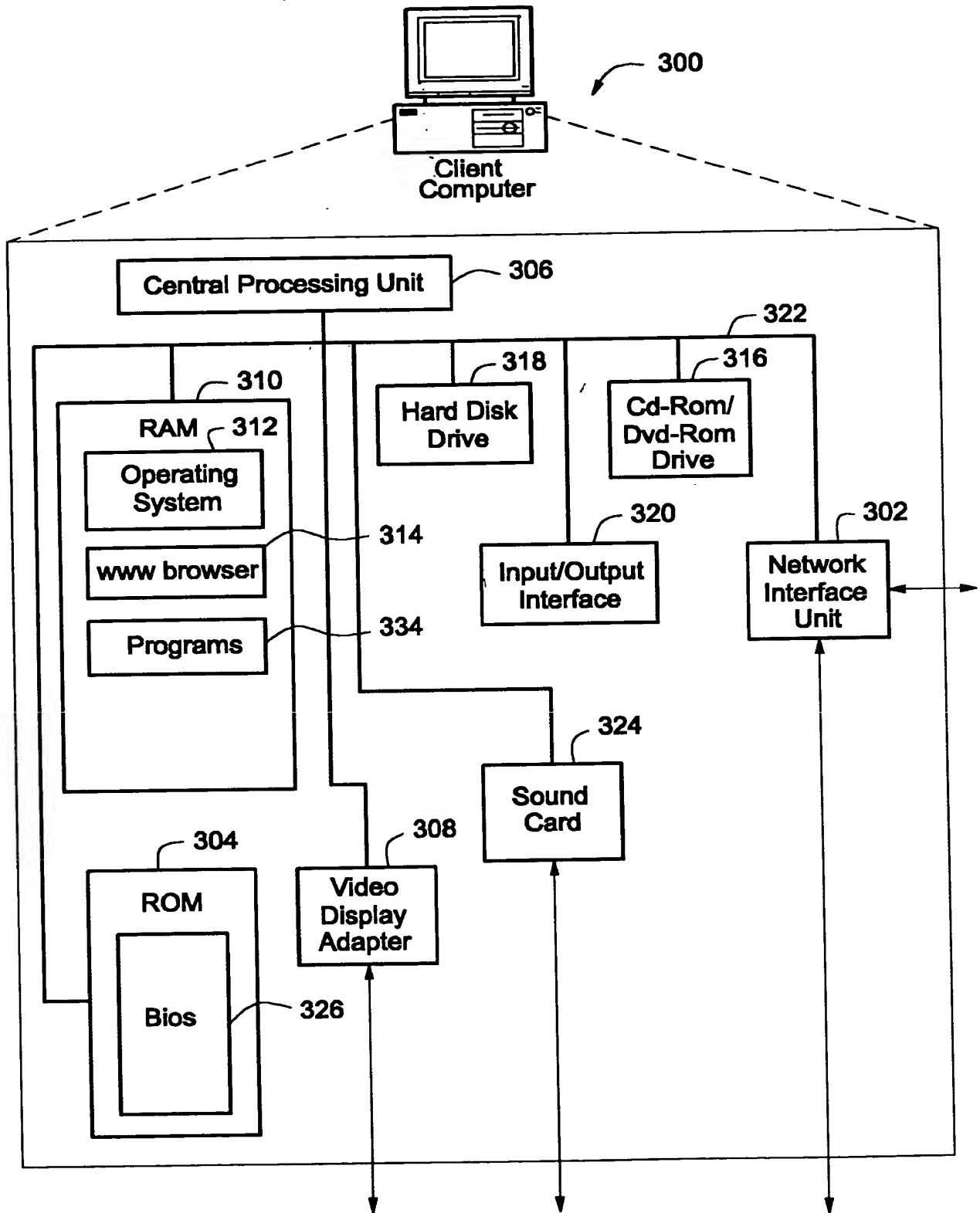


Figure 3



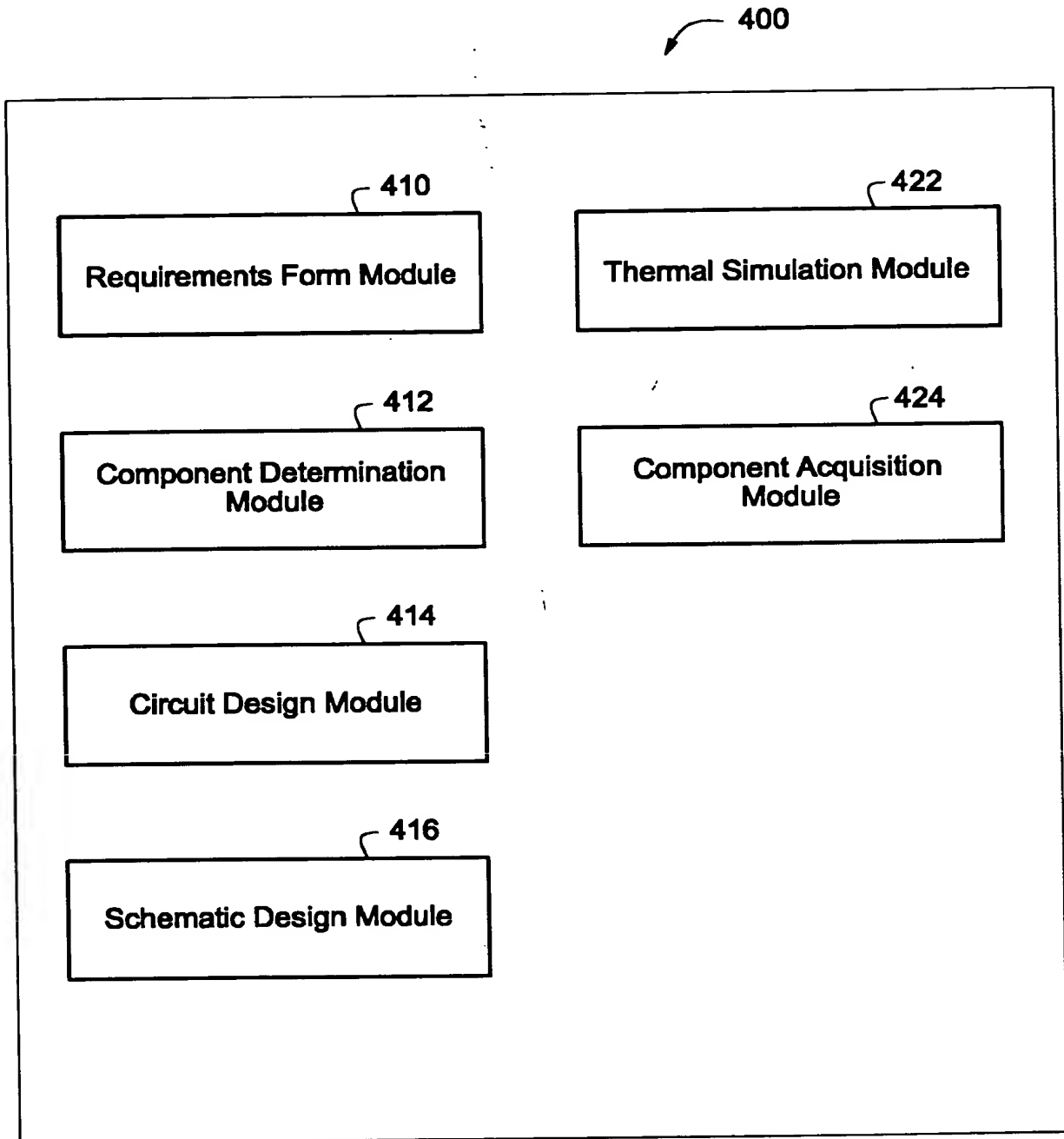
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**Figure 4**



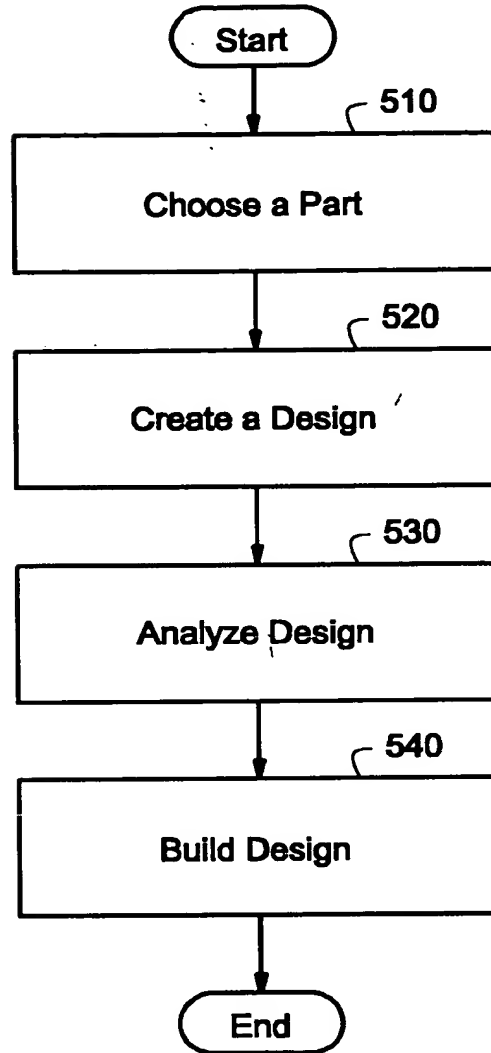
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**Figure 5**



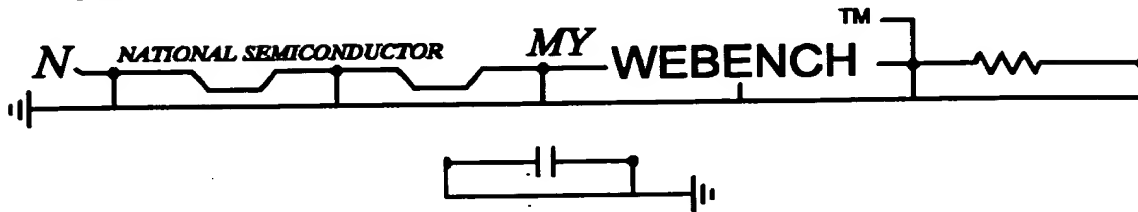
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Welcome to your  
power Webench™!

"Tools for the power design engineer"

**START HERE** — 605  
to design a power supply.

### How to use Webench

Just four easy steps to design a power supply! Just click on the items below for help on that step.

- 620  
1 Choose a Part — choose a specific part or input your system specifications to find those devices that fit.
- 630  
2 Create a Design — a design will be created for you including any necessary passive components and important calculated operating values.
- 640  
3 Analyze a Design — use WebSim™, the online power simulator, to validate your design electrically, and WebTHERM™, the online thermal simulator to visualize the thermal behavior of your design.
- 650  
4 Build It! — buy a part, a kit of parts, or an evaluation board.

See Our Disclaimer

### Features

WebSIM™, is a browser-based simulator which allows you to probe points in th

### My Designs

Your Last 4 Designs:

- Design #6
  - Design #5
  - Design #4
  - Design #3
- 660  
670

MY Designs Shows all of your Designs

My WebSIM™ Simulations — 680

My WebTHERM™ Simulations — 690

My BuildIt Order — 695

### Other Power Webench Tools

Switchers Made Simple™ is downloadable software that enables you to develop a complete power supply design on your local PC. This covers Simple Switcher devices and includes discrete component and manufacturer selection.

SMS 6.1 (for LM267x and LM259x buck regulators, and LM258x and LM2577 boost & flyback regulators) updated!

SMS 3.3 (for LM257X)

### Wireless Webench Tools

Wireless Easy PLL Design Assistant

Figure 6



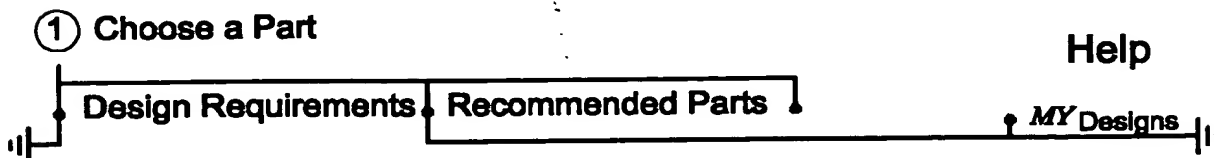
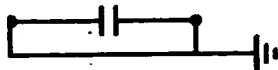
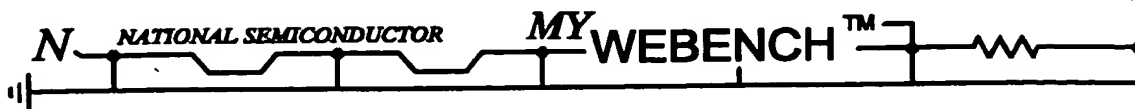
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Enter your power supply design requirements.

Basic Selections

702 {	Vin Min	<input type="text" value="20"/>	V	Output Voltage	<input type="text" value="5 Volts"/>	}	704
	Vin Max	<input type="text" value="22"/>	V	V out	I out		
				Output #1	<input type="text" value="5.0"/> V	<input type="text" value="5"/> A	

Choose Additional Features (Optional)

				706		
On/Off Pin	<input type="radio"/> No	<input type="radio"/> Yes	<input checked="" type="radio"/> Ignore	Output 2	<input type="text"/> V	<input type="text"/> A
Error Flag	<input type="radio"/> No	<input type="radio"/> Yes	<input checked="" type="radio"/> Ignore	Output 3	<input type="text"/> V	<input type="text"/> A
Sync Pin	<input type="radio"/> No	<input type="radio"/> Yes	<input checked="" type="radio"/> Ignore			

Show Recommended Power Management ICs 708



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Figure 7



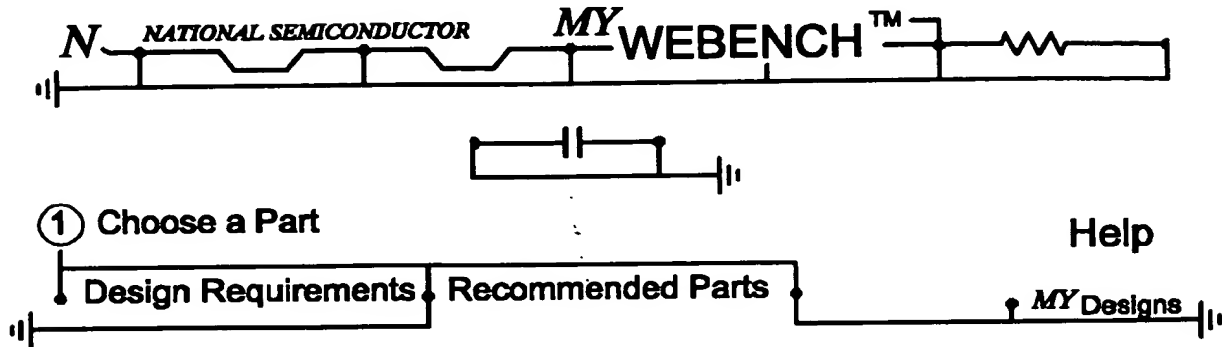
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**Your Design Specifications**

<b>VinMin : 20.0 V</b> <b>VinMax : 22.0 V</b>	<b>Output #1</b> <b>Vout = 5.0 V</b> <b>Iout = 5.0 A</b>
--	--

**Suggested Switching Regulators - Buck Topology**

Product Folder	Webench Tools	Max Curr.	Typ. Eff.	On/ Off	Err. Pin	Other Features	Freq. kHz	Est. Price
<u>LM2678-5.0</u>	Create Design	5.0A	84%	Y	Y		260	\$3.84
	WebTHERM™ Enabled Build It - Custom Kit							
<u>LM2678-ADJ</u>	Create Design	5.0A	84%	Y	Y	Adj. Vout	260	\$3.84
	WebTHERM™ Enabled Build It - Custom Kit							
<u>LM2679-5.0</u>	Create Design	5.0A	84%	Y	Y	SoftStart, Adj. Peak Current limit	260	\$4.07
	WebTHERM™ Enabled Build It - Custom Kit							
804 <u>LM2679-ADJ</u>	Create Design	5.0A	84%	Y	Y	SoftStart, Adj. Peak Current Limit, Adj. Vout	260	\$4.07
	WebTHERM™ Enabled Build It - Custom Kit							

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**Figure 8A**



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**Suggested Switching Regulators - Flyback Topology**

Product Folder	Webench Tools	Max Curr.	Typ. Eff.	On/ Off	Err. Pin	Other Features	Freq. kHz	Est. Price
<u>LM2585-5.0</u>	Create Design	3.0A	93%	N	N	SoftStart	100	\$3.42
<u>LM2585-ADJ</u>	Create Design	3.0A	80%	N	N	SoftStart, Adj. Vout	100	\$3.42
<u>LM2586-5.0</u>	Create Design	3.0A	80%	Y	N	Sync, SoftStart	100	\$3.45
<u>LM2586-ADJ</u>	Create Design	3.0A	80%	Y	N	Sync, SoftStart, Adj. Vout	100	\$3.45
<u>LM2587-5.0</u>	Create Design	5.0A	80%	N	N	SoftStart	100	\$4.51
<u>LM2587-ADJ</u>	Create Design	5.0A	80%	N	N	SoftStart, Adj. Vout	100	\$4.51
<u>LM2588-5.0</u>	Create Design	5.0A	80%	Y	N	Sync, SoftStart	100	\$4.61
<u>LM2588-ADJ</u>	Create Design	5.0A	80%	Y	N	Sync, SoftStart, Adj. Vout	100	\$4.61
<u>LM2577-ADJ</u>	Create Design	3.0A	80%	N	N	SoftStart, Adj. Vout	52	\$3.15

**Figure 8B**



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Design - Purchasing - Quality - Company - Jobs

Design - Purchasing - Quality - Company - Jobs



Products > Analog - Regulators > Simple Switchers > LM2679

Product Folder

905

Live Simulation

Buy LM2679-5.0 Evaluation Board

# LM2679 SIMPLE SWITCHER 5A Step-Down Voltage Regulator with Adjustable Current Limit

Generic P/N 2679

## Contents

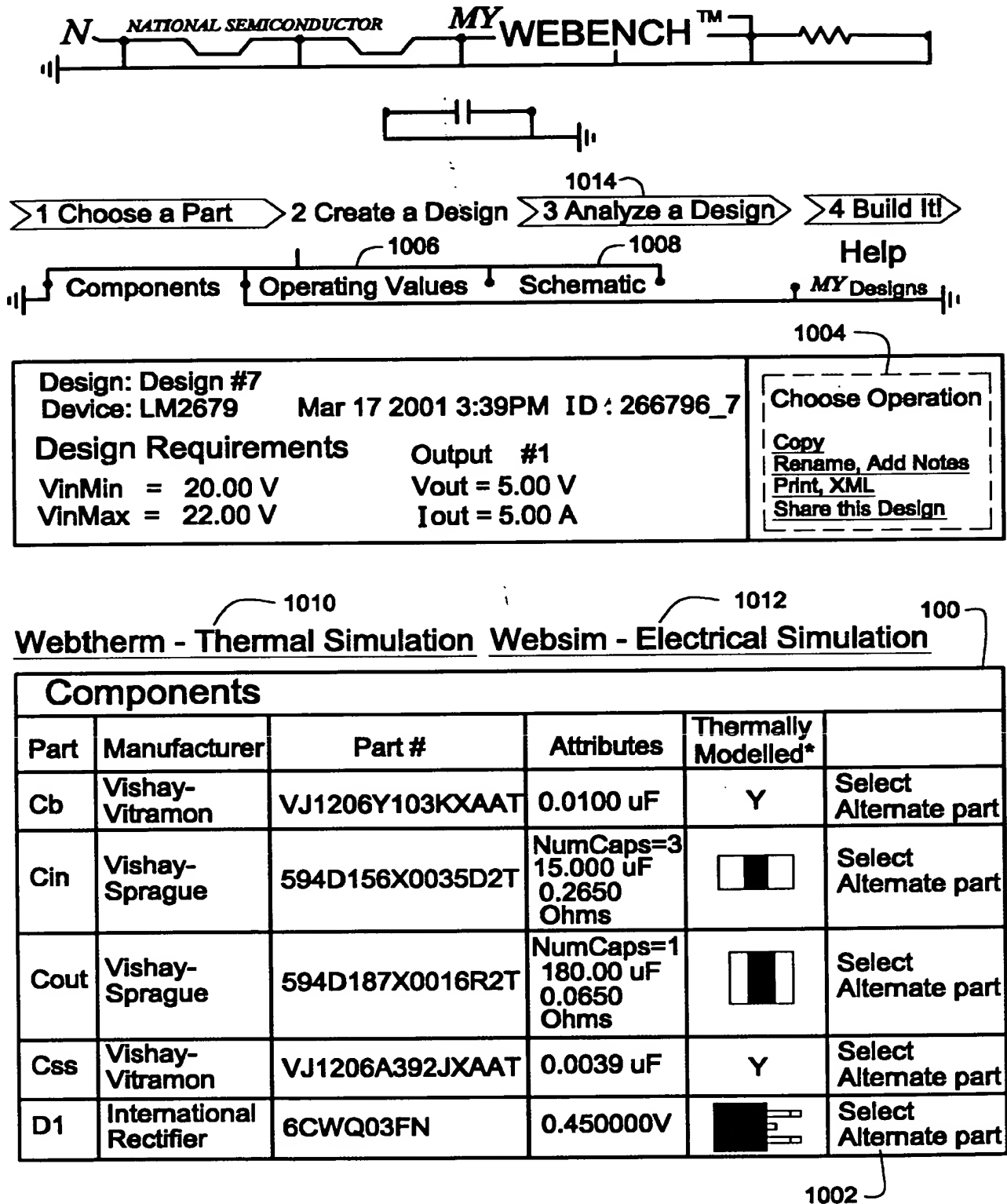
902

- General Description
- Features
- Applications
- Datasheet
- Package Availability, Models, Samples & Pricing
- Design Tools

Parametric Table	
Multiple Output Capability	No
On/Off Pin	Yes
Error Flag	Yes
Input Voltage, min (Volt)	8, 15
Input Voltage, max (Volt)	40
Output Current, max	5 Amps
Output Voltage (Volt)	5, 12, 3.30
Adjustable Output Voltage	No, Yes
Switching Frequency (Hz)	260000
Adjustable Switching Frequency	No
Sync Pin	No
Efficiency (%)	84, 92, 82
Flyback	No
Step-up	No
Step-down	Yes

904

Figure 9



## Figure 10A





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IC	National Semi- conductor	<u>LM2679S-ADJ</u>	ADJV,Buck		Select Alternate part
L1	Coiltronics	UP4B-150	15.000 uH, 0.0200 Ohms		Select Alternate part
Rfb1	Vishay-Dale	CRCW1206- 1001FRT1	1000 Ohms	Y	Select Alternate part
Rfb2	Vishay-Dale	CRCW1206- 3161FRT1	3160 Ohms	Y	Select Alternate part
Rilim	Vishay-Dale	CRCW1206- 4991FRT1	4990 Ohms	Y	Select Alternate part

\* Components marked "Y" are not required for Thermal Simulation.



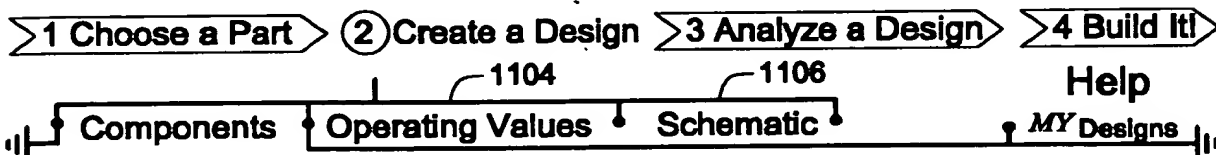
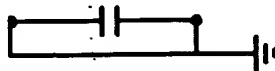
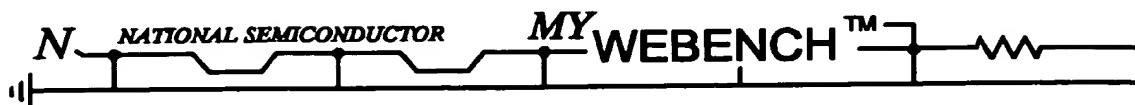
**Figure 10B**



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Design: Design #7  
Device: LM2679 Mar 17 2001 3:39PM ID: 266796\_7  
Design Requirements Output #1  
VinMin = 20.00 V Vout = 5.00 V  
VinMax = 22.00 V Iout = 5.00 A

Select Alternate for Component D1								
Please select from the list of available alternates below. Click on the " Update BOM " button when you are done.								
Update - BOM 1102								
Alternates	Part # Manufacturer	Thermally Modelled	Forward Voltage Drop	Max Rated Current	Max Voltage Rating	x,y,z in mm	Price	Quantity Available
Custom <input type="radio"/>	<input type="text"/>	N	Limit = 0.00 <input type="text"/> V	1110 Limit > = 5.00	1112 Limit > = 28.4			
1 <input type="radio"/>	6CWQ03FN International Rectifier		0.45000V	7.000A	30.00V	10.42 6.73 2.38	\$0.85	>10 in stock
2 <input type="radio"/>	50WQ03FN International Rectifier		0.46000V	5.500A	30.00V	10.42 6.73 2.38	\$1.83	>10 in stock
3 <input type="radio"/>	12CWQ03- FNTRL International Rectifier		0.47000V	12.00A	30.00V	10.42 6.73 2.38	\$0.82	>10 In stock
4 <input type="radio"/>	50WQ04FN International Rectifier		0.51000V	5.500A	40.00V	10.42 6.73 2.38	\$1.33	>10 In stock

Figure 11A



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5 ○	<u>12CWQ04FN</u> <u>International</u> <u>Rectifier</u>		0.52000V	12.00A	40.00V	10.42 6.73 2.38	\$1.48	>10 in stock
6 ○	<u>6CWQ04FN</u> <u>International</u> <u>Rectifier</u>		0.53000V	7.000A	40.00V	10.42 6.73 2.38	\$1.00	>10 in stock
7 ○	<u>50WQ06FN</u> <u>International</u> <u>Rectifier</u>		0.57000V	5.500A	60.00V	10.42 6.73 2.38	\$1.07	>10 in stock
8 ○	<u>12CWQ06FN</u> <u>International</u> <u>Rectifier</u>		0.61000V	12.00A	60.00V	10.42 6.73 2.38	\$0.72	>10 in stock
9 ○	<u>6CWQ06-</u> <u>FNTR</u> <u>International</u> <u>Rectifier</u>		0.61000V	7.000A	60.00V	10.42 6.73 2.38	\$1.08	>10 in stock

Figure 11B



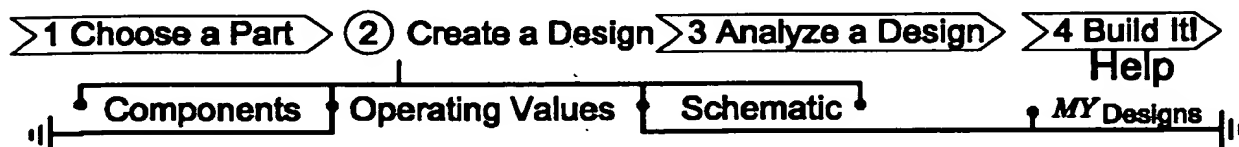
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Inventors: Jeffrey R. Perry et al.

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Design: Design #7	Mar 17 2001	ID:	Choose Operation
Device: LM2679	3:39:00:000PM	266796_7	
Design Requirements	Output #1		<a href="#">Copy</a> <a href="#">Rename, Add Notes</a> <a href="#">Print XML</a> <a href="#">Share this Design</a>
VinMin = 20.00 V	Vout = 5.00 V		
VinMax = 22.00 V	Iout = 5.00 A		

Vin:  V Iout:  A

Operating Values			
#	Description	Parameter	Value
1	Pulse Width Modulation (PWM) Frequency	Frequency	260 kHz
2	Continuous or Discontinuous Conduction Mode, inductor current goes to zero in Discontinuous Conduction	Mode	Cont
3	Total Output Power	Pout	25.0W
4	Vin operating point	Vin Op	22.00V
5	Iout operating point	Iout Op	5.00A

Operating Point at Vin = 22.00 V, 5.00 A			
#	Description	Parameter	Value
1	Bode Plot Crossover Frequency, indication of bandwidth of supply	Cross Freq	97.7 kHz
2	Steady State PWM Duty Cycle, range limits from 0 to 100	Duty Cycle	25.8%
3	Steady State Efficiency	Efficiency	85.3%
4	IC Junction Temperature	IC Tj	120 °C
5	IC Junction to Ambient Thermal Resistance	ICThetaJA	34.9 °C/W
6	Bode Plot Phase Margin	Phase Marg	71.0 Deg
7	Peak-to-peak ripple voltage	Vout p-p	0.07 V

Figure 12A



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<b>Current Analysis</b>			
#	Description	Parameter	Value
1	Input Capacitor RMS ripple current	Cin IRMS	2.2 A
2	Output Capacitor RMS ripple current	Cout IRMS	0.20 A
3	Peak Current in IC for Steady State Operating Point	IC Ipk	5.5 A
4	ICs Maximum rated peak current	IC Ipk Max	7.4 A
5	Average input current	I In Avg	2.3 A
6	Inductor ripple current, peak-to-peak Value	L Ipp	1.1 A

<b>Power Dissipation Analysis</b>			
#	Description	Parameter	Value
1	Input Capacitor Power Dissipation	Cin Pd	0.43 W
2	Output Capacitor Power Dissipation	Cout Pd	0.0026 W
3	Diode Power Dissipation	Diode Pd	1.9 W
4	IC Power Dissipation	IC Pd	1.4 W
5	Inductor Power Dissipation	L Pd	0.50 W



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**Figure 12B**



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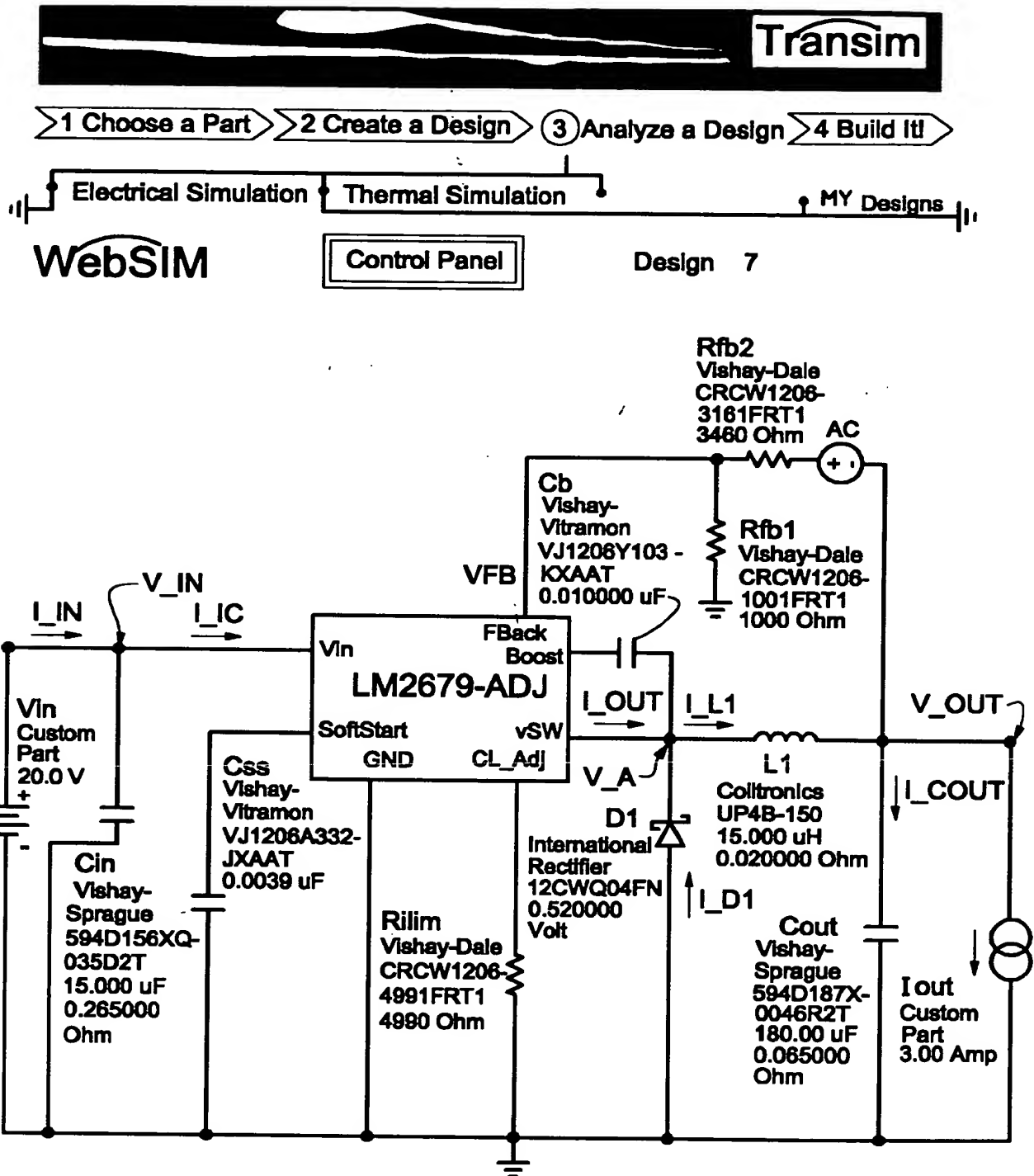


Figure 13



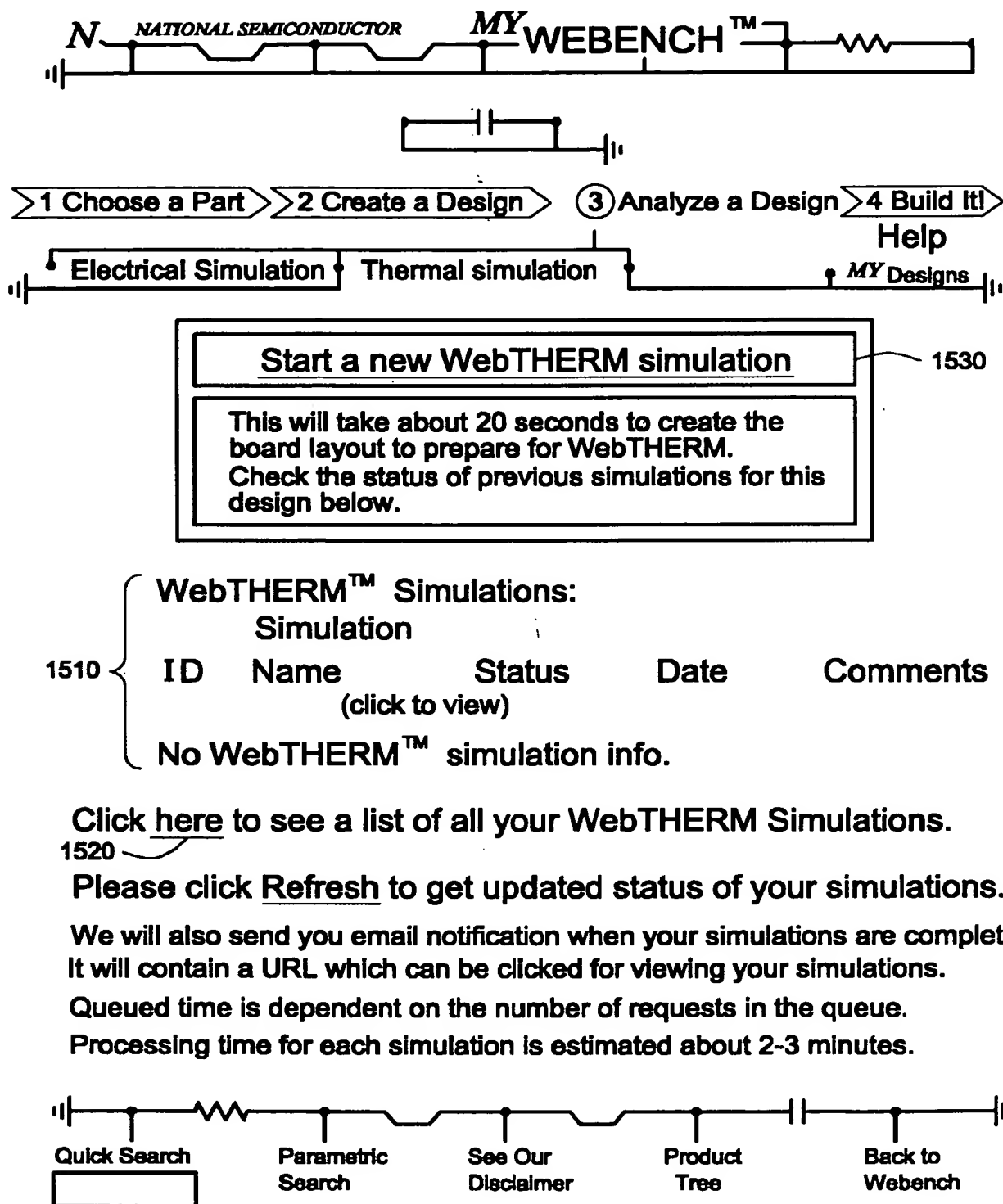
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Figure 14



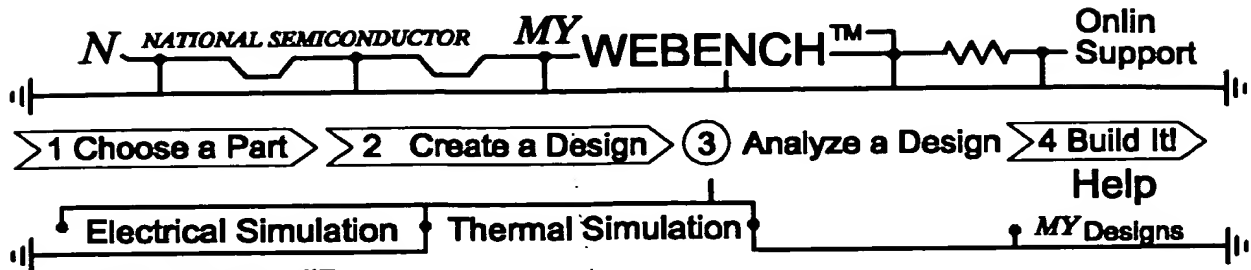
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Design: Design #7

Device: LM2679

Mar 17 2001 3:39:00:000PM

ID: 266796\_7

Design Requirements

Output #1

VinMin = 20.00 V

Vout = 5.00 V

VinMax = 22.00 V

Iout = 5.00 A

WebTHERM™

Powered by: FLOMERICS

When you have entered all your data, click here:

**SUBMIT for new simulation**

1670

Simulation ID : 4

Name This Simulation:

1660

Simulation for Design 7

Comments:

1665

Environment:

Operating Conditions

Vin: 22.00 V Iout 5.00 A

Ambient Temperature

On Bottom: On Top:

1650 { 30 °C 30 °C

Board Conditions

Copper Weight

1 OZ. (0.03558 mm)

1680

Board Orientation:

Component Side Up

Air Flow

Direction: Velocity:

Edge Temperatures:



Edge 1

Insulated OR

1630

N/A °C

1645  
Edge 4



Insulated  
OR

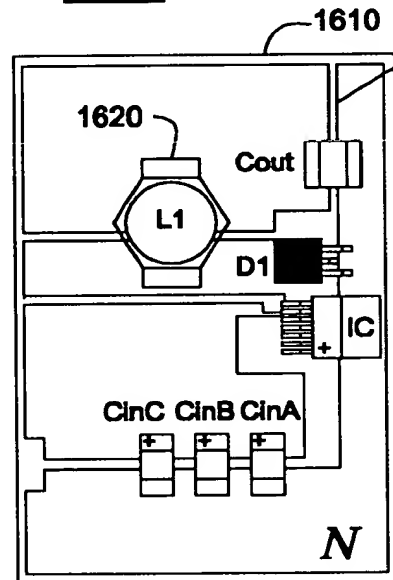
N/A  
°C

1615  
Edge 2



Insulated  
OR

N/A  
°C



Edge 3

Insulated OR

N/A

°C

Figure 15A



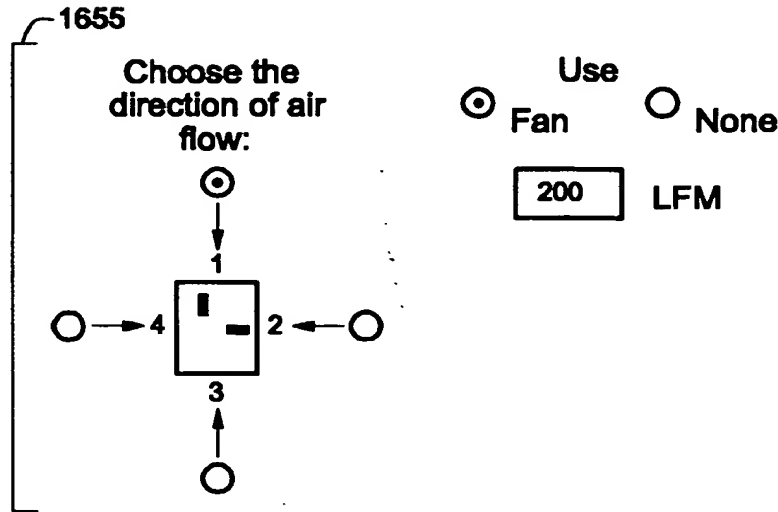
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BOM			
Component	Power Dissipation	Manufacturer	Part#
Cin	0.43 W	Vishay-Sprague	594D156X0035D2T
Cout	0.0026 W	Vishay-Sprague	594D187X0016R2T
D1	1.9 W	International Rectifier	12CWQ04FN
IC	1.4 W	National Semiconductor	LM2679
L1	0.50 W	Coiltronics	UP4B-150

## Design Assistant Messages

All components fit!



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Figure 15B

Title: METHOD TO PERFORM THERMAL SIMULATION  
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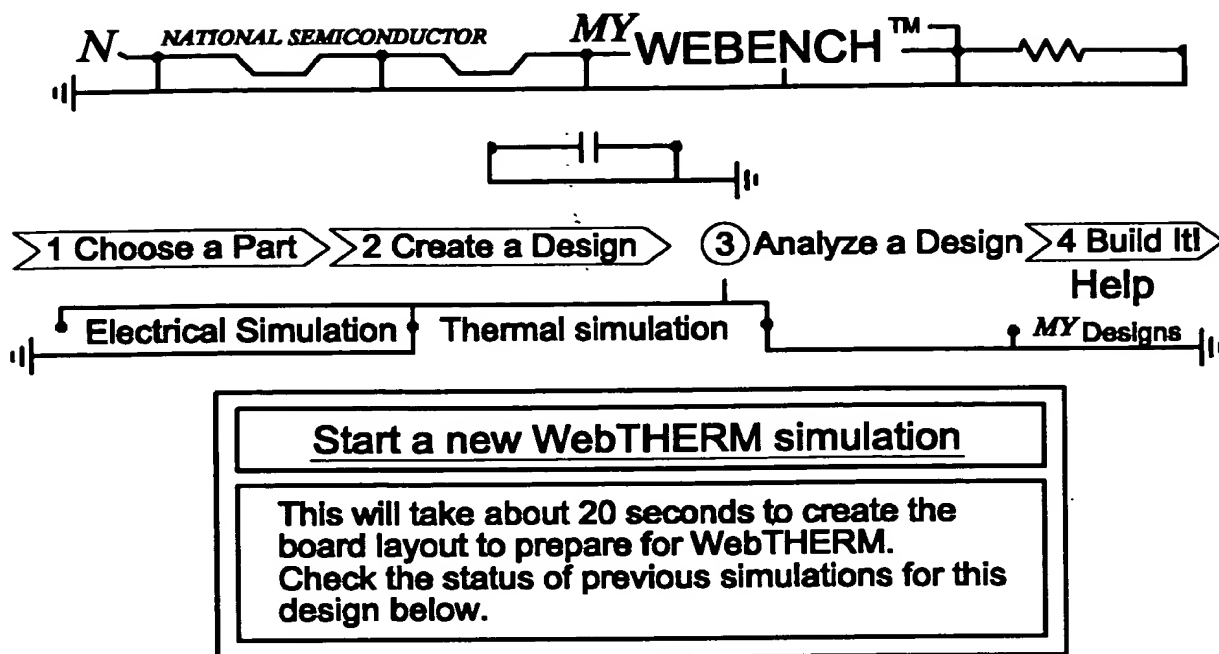
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WebTHERM™ Simulations :  
Simulation

ID	Name	Status	Date	Comments
	(click to view)			
7 = Design ID	Simulations for Design ID : 7			Design ID : 7
1	Simulation for Design 7	queued	Mar 17 2001 5 : 05 : 45 PM	

1710

Please click Refresh to get updated status of your simulations.

We will also send you email notification when your simulations are complete. It will contain a URL which can be clicked for viewing your simulations.

Queued time is dependent on the number of requests in the queue.

Processing time for each simulation is estimated about 2-3 minutes.



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Figure 16



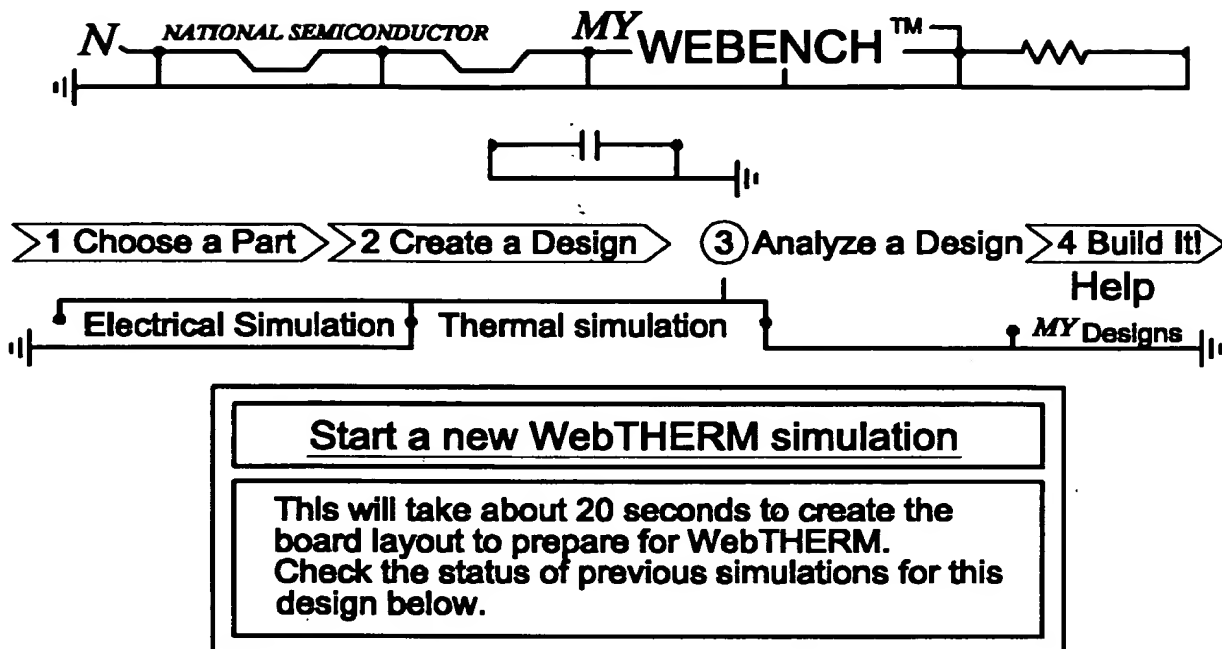
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WebTHERM™ Simulations :  
Simulation

ID	Name	Status	Date	Comments
	(click to view)			
7 = Design ID	Simulations for Design ID : 7			Design ID : 7
1	Simulation for Design 7	Processing	Mar 17 2001 5 : 05 : 57 PM	

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Figure 17



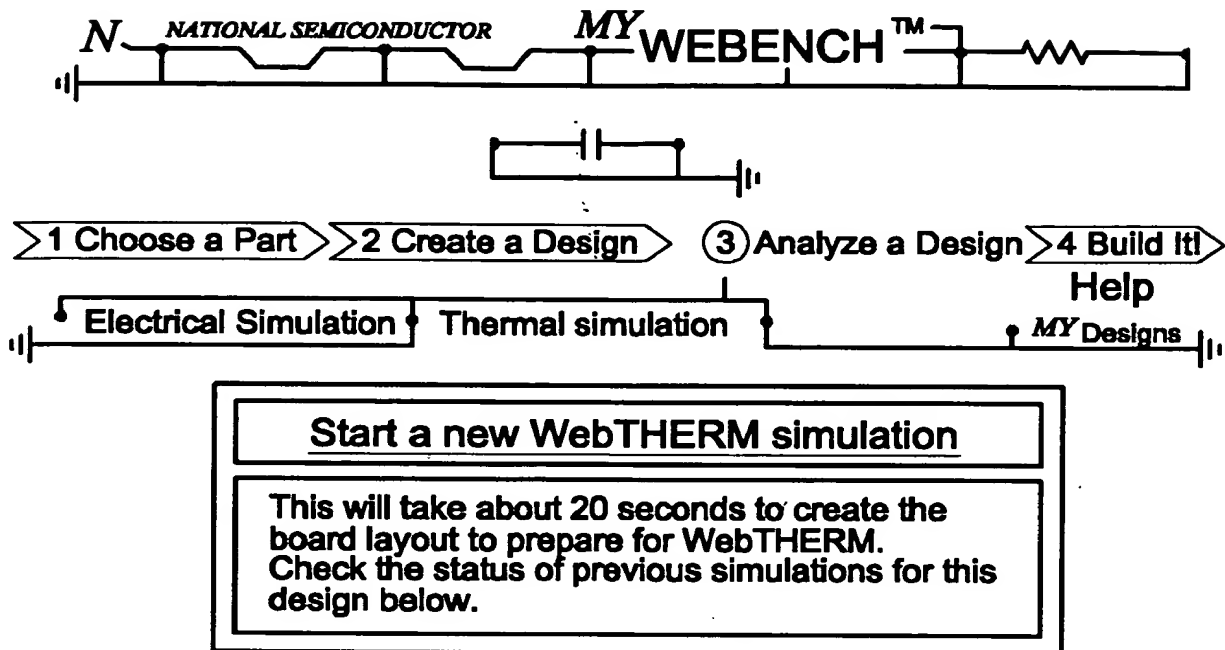
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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WebTHERM™ Simulations :  
Simulation

ID	Name	Status	Date	Comments
	(click to view)			
7 = Design ID	Simulations for Design	D : 7	Design ID : 7	
1	<u>Simulation for Design 7</u>	<u>Completed</u>	Mar 17 2001 5 : 10 : 22 PM	

Please click Refresh to get updated status of your simulations.

We will also send you email notification when your simulations are complete, It will contain a URL which can be clicked for viewing your simulations.

Queued time is dependent on the number of requests in the queue.

Processing time for each simulation is estimated about 2-3 minutes.



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Figure 18



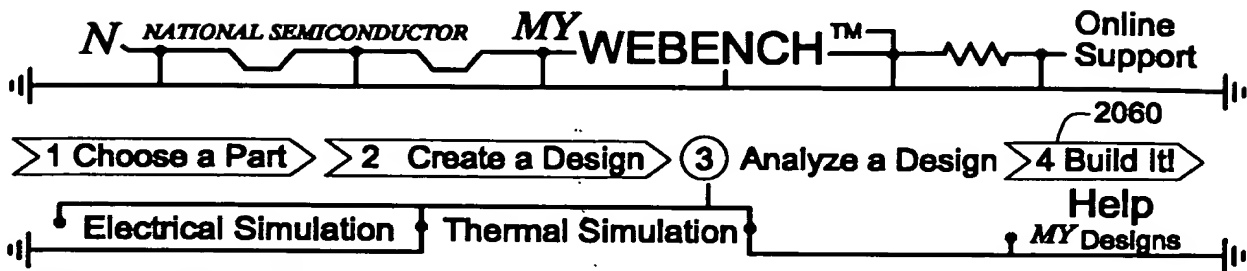
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Design: Design #7

Device: LM2679

Mar 17 2001 3:39:00:000PM

I D: 266796\_7

Design Requirements

Output #1

VinMin = 20.00 V

Vout = 5.00 V

VinMax = 22.00 V

Iout = 5.00 A

WebTHERM™

Powered by:

Download Flomerics SMARTPART™

FLOMERICS model

Simulation ID : 1

Name This

Simulation:

Simulation for  
Design 7

Environment:

Operating  
Conditions

Vin: 22.00 V

Iout: 5.00A

Ambient  
Temperature

On

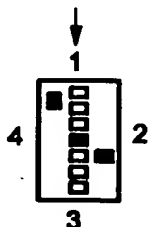
Bottom: 30 °C On Top:  
30 °C

Board Conditions

Copper Weight  
0.5 OZ. (0.01778 mm)

Board Orientation  
Component Side Up

Air Flow  
Direction Velocity:  
of Air  
flow: No Fan



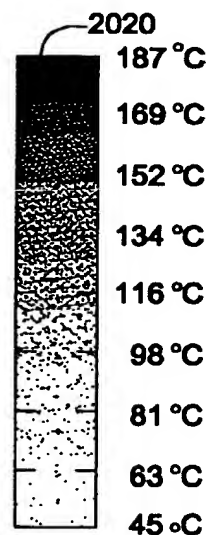
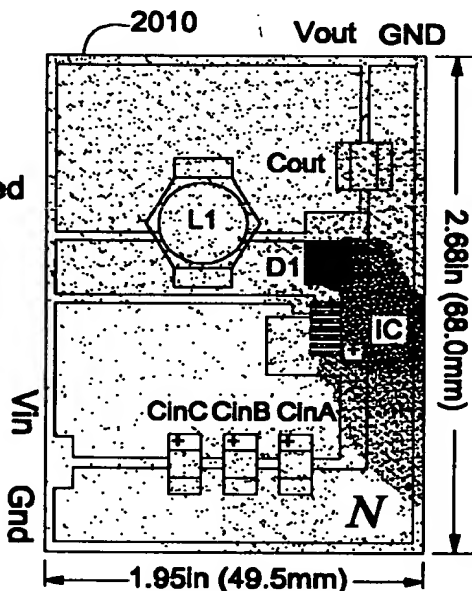
Do another simulation

Edge Temperatures:

Edge 1  
Insulated

Edge 4  
Insulated

Edge 2  
Insulated



Edge 3  
Insulated

Temperature Bar Scaling

Click [here](#) to recolor your thermal image.

Max Colorbar Temperature 188 °C

Min Colorbar Temperature 48 °C

Figure 19A



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Operating Temperatures				
Layer	Max Temp.	Manufacturer	Part #	Warnings
Cin	82 °C	Vishay-Sprague	594D156X0035D2T	
Cout	92 °C	Vishay-Sprague	594D187X0016R2T	
D1 - Diode	188 °C	International Rectifier	12CWQ04FN	
IC - Die	174 °C	National Semiconductor	LM2679	There is some potential problem with this design
IC - Top	165 °C			
L1 - Inductor	82 °C	Coiltronics	UP4B-150	
PCB	182 °C			

### Design Assistant Messages

All components fit!



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Figure 19B



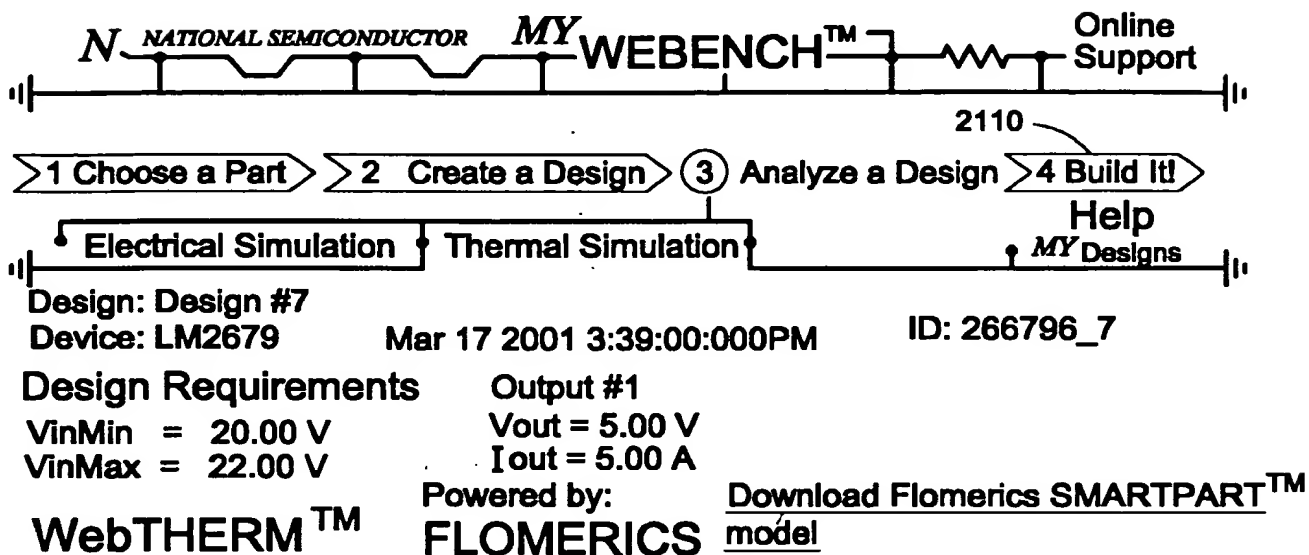
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Simulation ID : 3  
Name This  
Simulation:  
Simulation for  
Design 7

Environment:

Operating  
Conditions

Vin: 22.00 V

Iout: 5.00A

Ambient  
Temperature

On

Bottom: On Top:

30 °C 30 °C

Board Conditions

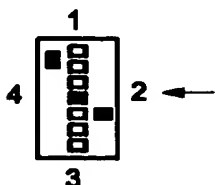
Copper Weight

0.5 OZ. (0.01778 mm)

Board Orientation:

Component Side Up

Air Flow  
Direction Velocity:  
of Air  
flow: 400LFM



Do another simulation

Edge Temperatures:

Edge 1  
Insulated

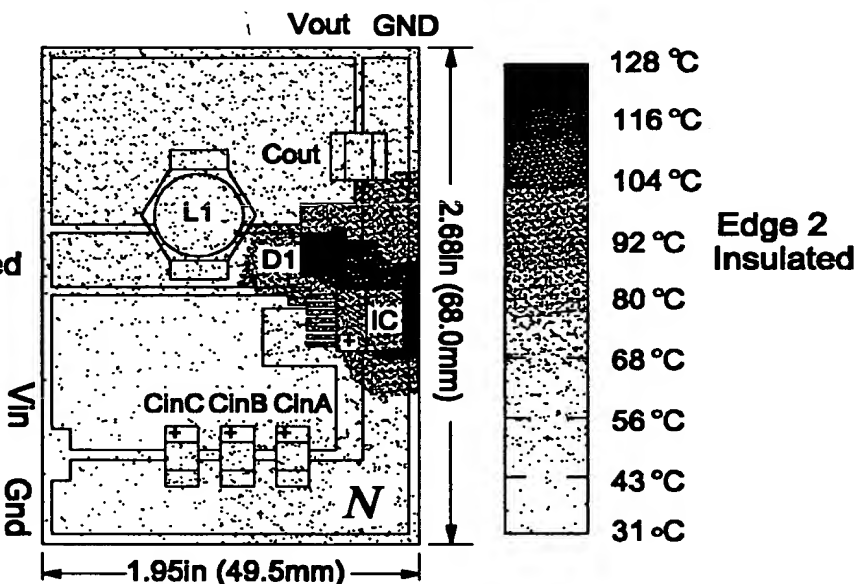


Figure 20A



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Operating Temperatures				
Layer	Max Temp.	Manufacturer	Part #	Warnings
Cin	50 °C	Vishay-Sprague	594D156X0035D2T	
Cout	50 °C	Vishay-Sprague	594D187X0016R2T	
D1 - Diode	128 °C	International Rectifier	12CWQ04FN	
IC - Die	112 °C	National Semiconductor	LM2679	There is some potential problem with this design.
IC - Top	97 °C			
L1 - Inductor	46 °C	Coiltronics	UP4B-150	
PCB	123 °C			

### Design Assistant Messages

All components fit



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Figure 20B



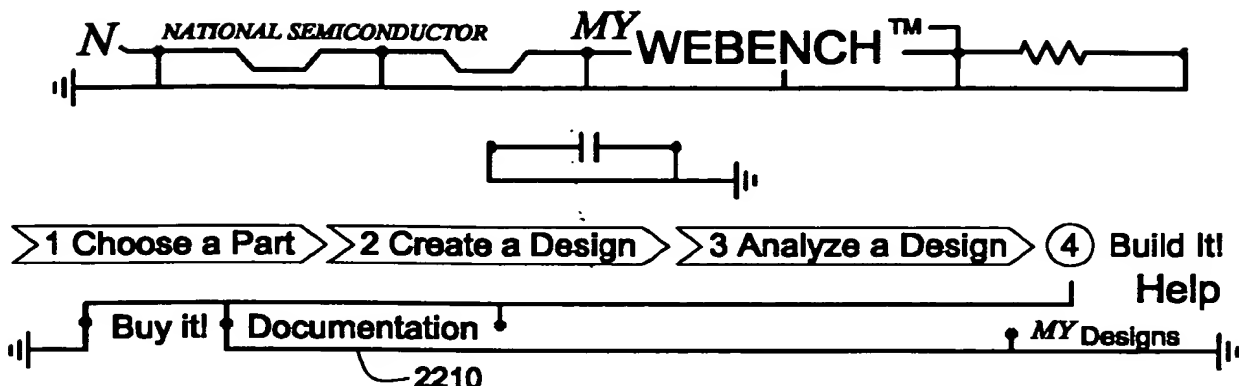
**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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**Design : 7**

Your design is supported by a Webench Custom Evaluation Kit. Ordering this kit from Pioneer-Standard provides you with everything you need to realize a prototype of your design quickly and at a very low price.

If for some reason you decide not to order the Custom Evaluation Kit you can always order only the IC from us here.




**Custom Evaluation Kit**

Bill of  
Materials

2220

2230

[View Assembly Doc](#) [Order this Kit from Pioneer-Standard >>](#)

Item	Manufacturer Part	Qty	Attributes	Component Name(s)	Pioneer Price	Pioneer Availability
1	International Rectifier 12CWQ04FN 	1	VF <sub>ratio</sub> = 0.52 V	D1	\$1.48	> 10 In Stock
2	Keystone 5015	4		TP1, TP2, TP3, TP6	\$0.20	> 10 In Stock
3	National Semiconductor 551011367-011	1	Surface Mount, etc	PC Board	\$5.00	> 10 In Stock
4	Vishay-Sprague 594D156X0035D2T 	3	Cap=15uF ESR= 0.265 Ohms	Cin	\$1.00	> 10 In Stock
5	Vishay-Sprague 594D187X0016R2T 	1	Cap=180uF ESR= 0.065 Ohms	Cout	\$1.00	> 10 In Stock

**Figure 21A**










Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Applicati n No. 09/846,681

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6	Vishay-Dale CRCW1206- 1001FRT1 	1	Resistance =1000 Ohms	Rfb1	\$0.03	> 10 in Stock
7	Vishay-Dale CRCW1206- 3161FRT1 	1	Resistance =3160 Ohms	Rfb2	\$0.03	> 10 in Stock
8	Vishay-Dale CRCW1206- 4991FRT1 	1	Resistance =4990 Ohms	Rilim	\$0.03	> 10 in Stock
9	National Semiconductor LM2679S-ADJ	1	Package=S, Voltage option=ADJ, Topology= Buck	IC	\$4.75	> 10 in Stock
10	Coiltronics UP4B-150 	1	L = 15uH DCR = 0.02 Ohms	L1	\$1.50	> 10 in Stock
11	Vishay-Vitramon  VJ1206A392JXAAT	1	Cap = 0.0039uF	Css	\$0.05	> 10 in Stock
12	Vishay-Vitramon  VJ1206Y103KXAAT	1	Cap = 0.01uF	Cb	\$0.05	> 10 in Stock
13	Vishay-Vitramon  VJ1206Y104KXAAT	1		Cinx	\$0.05	> 10 in Stock
				Total	\$17.77	

Bill of  
Materials

[View Assembly Doc](#)

[Order this Kit from Pioneer-Standard >>](#)

### Order the IC

- [Order the LM2679S-ADJ in volume](#)
- [Order a Free Sample](#)

### Generic Eval Board for LM2679

- [Buy Eval Board for LM2679](#)
- [Download Protel File \(See Notes Below\)](#)

The Protel files are saved as Self Extracting Zip Archives. To download a product's Protel file, click on the corresponding "Protel file now" link, and save the link as a file on your computer. Then run the file on your computer (double click). This will automatically decompress th Protel file to your computer's disk.

Note: You must have Protel software or other software that can read Protel PCB layout fil s in order to take advantage of these Protel files.



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Figure 21B



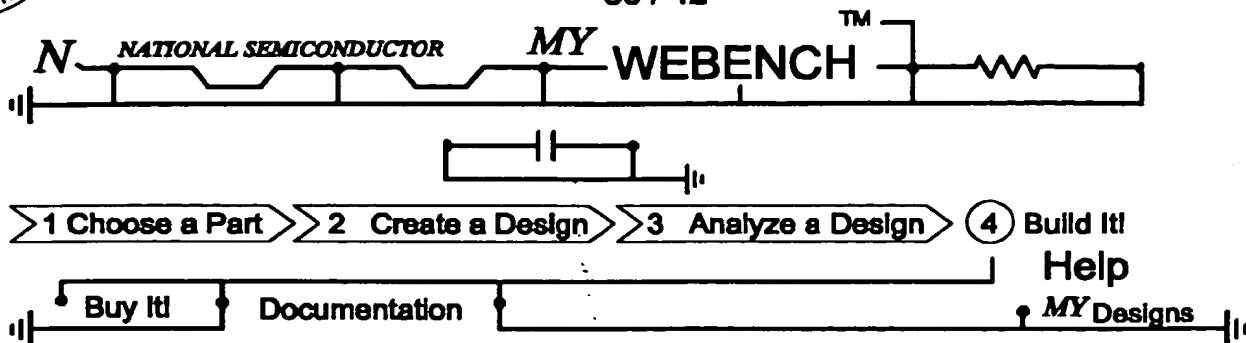
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Assembly Document for Your LM2679 Design # : 7  
LM2679 SMD Evaluation Board (LM2679BU1PWB)

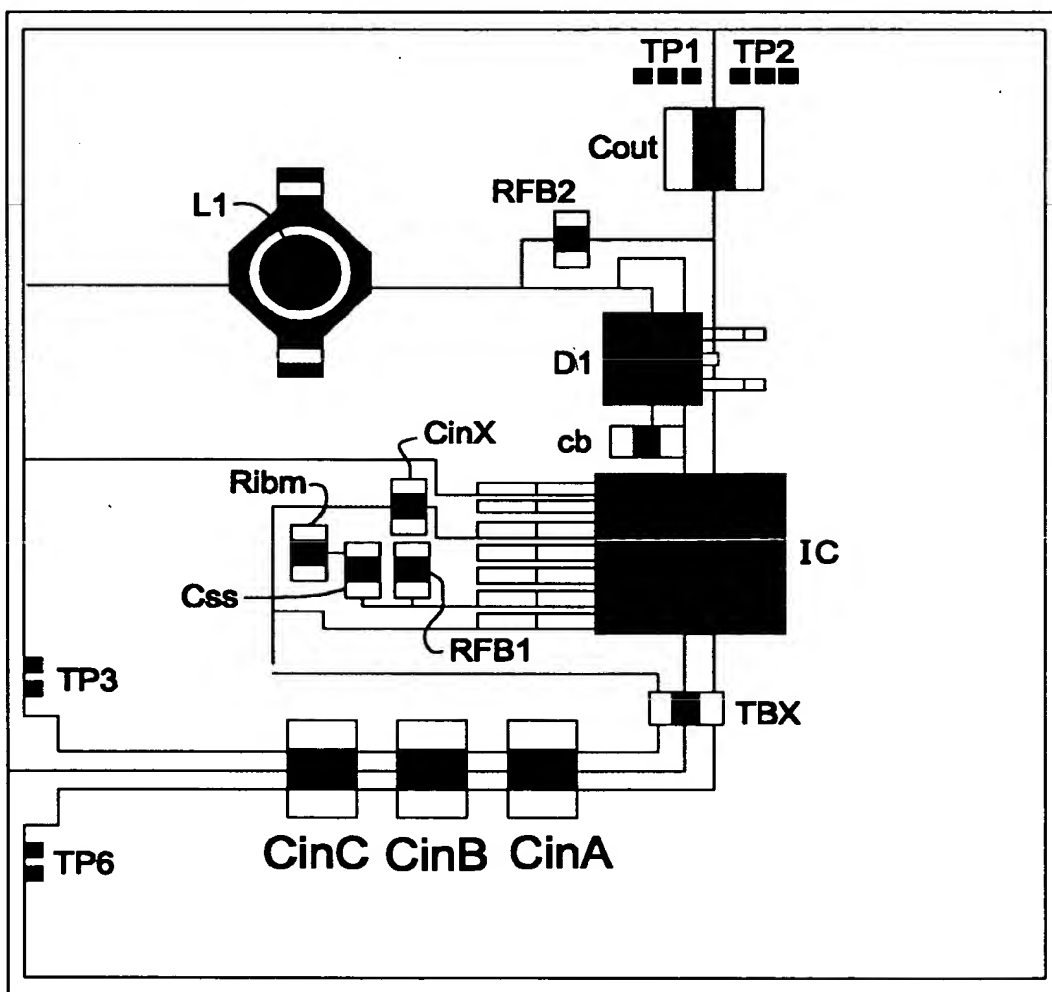


FIGURE 1 - Assembly Diagram

[Download the Board Layout in Protel format.](#)

GENERAL DESCRIPTION

Figure 22A



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681




Docket No. 50019.44US01/PO4884

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The LM2679 SMD Evaluation Board is designed to provide a flexible PCB platform for customers to develop and test custom power supply designs using tools available on the POWER.NATIONAL.COM website. The LM2679BU1PWB is a single sided surface mount layout using 1 oz copper. The overall board dimensions are 2.475" x 2.700". All components are mounted on the topside copper. WEBENCH™ has automatically placed the components on this board to make sure that the input capacitor Cin (and Cinx ) and the diode D1 are as close to the IC as is reasonable minimizing stray circuit inductance. L1 and Cout should also be as close to the IC as reasonable but mostly to minimize the overall dimensions of the required PCB area for the power supply.

The LM2679 SMD Evaluation Board consists of a single layer PCB layout providing major landing areas on the PCB for the power conversion components: Inductor, Diode, Input and Output Capacitors as well as parameter setting small signal passive (resistors and capacitors) in 1206 packages and surface mount test points. Some components are optional or specific to an application, these are highlighted in the schematic. The PCB layout can be optimized for a specific design and lends itself to be dimensionally scalable (i.e. your particular design may have unused board area that can be "cut out" in the final application. This topic is covered in the PCB Layout Optimization section.

### Bill of Materials (BOM).

Item	Manufacturer Part	Qty	Attributes	Component Name(s)
1	International Rectifier 12CWQ04FN 	1	VF <sub>ratio</sub> = 0.52 V	D1
2	Keystone 5015	4		TP1, TP2, TP3, TP6
3	National Semiconductor 551011367-011	1	Surface mount, etc	PC Board
4	Vishay-Sprague 594D156X0035D2T 	3	Cap=15uF ESR=0.265 Ohms	Cin
5	Vishay-Sprague 594D187X0016R2T 	1	Cap=180uF ESR=0.065 Ohms	Cout

**Figure 22B**










**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

**Inventors: Jeffrey R. Perry et al.**

**Application No. 09/846,681**

**Docket No. 50019.44US01/PO4884**

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<b>6</b>	<b>Vishay-Dale</b> <b>CRCW1206-1001FRT1</b> 	<b>1</b>	<b>Resistance = 1000 Ohms</b>	<b>Rfb1</b>
<b>7</b>	<b>Vishay-Dale</b> <b>CRCW1206-3161FRT1</b> 	<b>1</b>	<b>Resistance = 3160 Ohms</b>	<b>Rfb2</b>
<b>8</b>	<b>Vishay-Dale</b> <b>CRCW1206-4991FRT1</b> 	<b>1</b>	<b>Resistance = 4990 Ohms</b>	<b>Rlim</b>
<b>9</b>	<b>National</b> <b>Semiconductor</b> <b>LM2679S-ADJ</b>	<b>1</b>	<b>Package=S,</b> <b>Voltage option=ADJ</b> <b>Topology=Buck</b>	<b>IC</b>
<b>10</b>	<b>Coiltronics</b> <b>UP4B-150</b> 	<b>1</b>	<b>L = 15uH</b> <b>DCR = 0.02 Ohms</b>	<b>L1</b>
<b>11</b>	<b>Vishay-Vitramon</b> <b>VJ1206A392JXAAT</b> 	<b>1</b>	<b>Cap = 0.0039uF</b>	<b>Css</b>
<b>12</b>	<b>Vishay-Vitramon</b> <b>VJ1206Y103KXAAT</b> 	<b>1</b>	<b>Cap = 0.01uF</b>	<b>Cb</b>
<b>13</b>	<b>Vishay-Vitramon</b> <b>VJ1206Y104KXAAT</b> 	<b>1</b>		<b>Cinx</b>

**SCHEMATIC**

The Schematic for the LM2679 is shown in FIGURE 2. U1, L1, D1, Cin and Cout are the basic power conversion components. Cinx as a high frequency bypass to the input to the LM2679. Rfb1, Rfb2, and Cf form the feedback network for the adjustable version of the LM2679. For Fixed output versions a zero Ohm resistor (jumper) should be used for Rfb2 (Rfb1 and Cf should be left off the board), this can be replaced by a copper trace as shown in the PCB Layout Optimization section. A space is reserved for a pull-down resistor, Ron, for the ON/OFF (Active low) pin, this may be desired if a Tri-State gate is driving this pin. Otherwise, if the ON/OFF pin is left floating, the LM2679 is normally ON.

**Figure 22C**

**Download the Schematic file in Protel format.**

It is best to power up the board by setting the supply voltage to the lowest operating input voltage ( $V_{in\ min}$ ) and set the supplies current limit to zero. With the supply off connect up the supply to  $V_{in}$  and GND. Connect a DVM to  $V_{out}$  and GND. Turn on the supply and slowly turn up the current limit. If the voltage starts to rise on the supply continue increasing the current while watching the output voltage. If the current increases on the supply but the voltage remains near zero there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the supply is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

### Figure 22D



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

**Inventors: Jeffrey R. Perry et al.**

**Application No. 09/846,681**

**Docket No. 50019.44US01/PO4884**

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**ARTWORK**

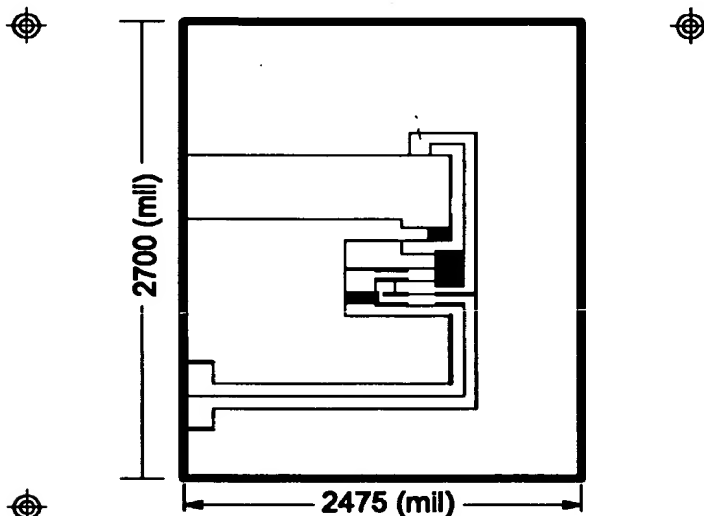
**FIGURE 3 shows the topside copper and FIGURE 4 shows the bottom side copper.**

**The intent of this board is to provide a flexible PCB layout to allow many different designs to be implemented using the same layout. In lower power designs you may find unused board space, that is not needed for electrical or thermal purposes. The overall layout lends itself to shrinking the design by trimming off the outer edges of the board.**

**Download the GERBER file for this PC Board.**

**NOTES: UNLESS OTHERWISE SPECIFIED**

- 1. NO FAB SHOP LOGO < DATE CODE REQUIRED**
- 2. APPLY GREEN (LPI) SOLDERMASK ON BOTH SIDES**
- 3. NO SILKSCREEN**
- 4. ADD UL RATING ON BOTTOM SIDE**
- 5. MATERIAL : FP - 1, GREEN**
- 6. BOARD THICKNESS : 0.063 WITH 1 oz COPPER**
- 7. FINISH : TIN - LEAD**



**MECHANICAL LAYER 551011367-011A  
TOP ETCH 551011367-011A**

**FIGURE 3 - Topside Cooper**

**NOTES: UNLESS OTHERWISE SPECIFIED**

- 1. NO FAB SHOP LOGO < DATE CODE REQUIRED**
- 2. APPLY GREEN (LPI) SOLDERMASK ON BOTH SIDES**
- 3. NO SILKSCREEN**
- 4. ADD UL RATING ON BOTTOM SIDE**
- 5. MATERIAL : FP - 1, GREEN**
- 6. BOARD THICKNESS: 0.063 WITH 1 oz COPPER**
- 7. FINISH : TIN - LEAD**

**Figure 22E**



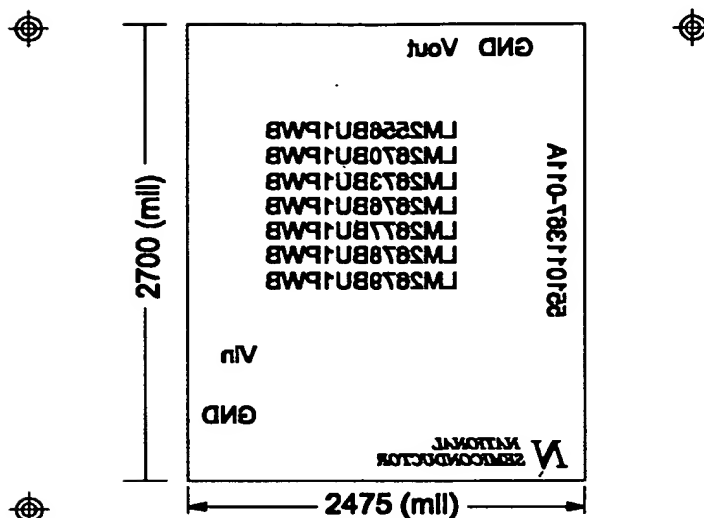
**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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MECHANICAL LAYER 551011367-011A

AT10-782110123 HOTE MOTTOB

**FIGURE 4 - Bottom Side Copper**

**Downloadable files**

**Schematic File**

The Schematic File in Protel format.

**Board Layout File**

Board Layout in Protel format.

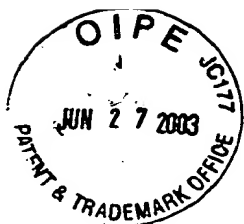
**GERBER File**

GERBER file for making the PC Board.



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**Figure 22F**



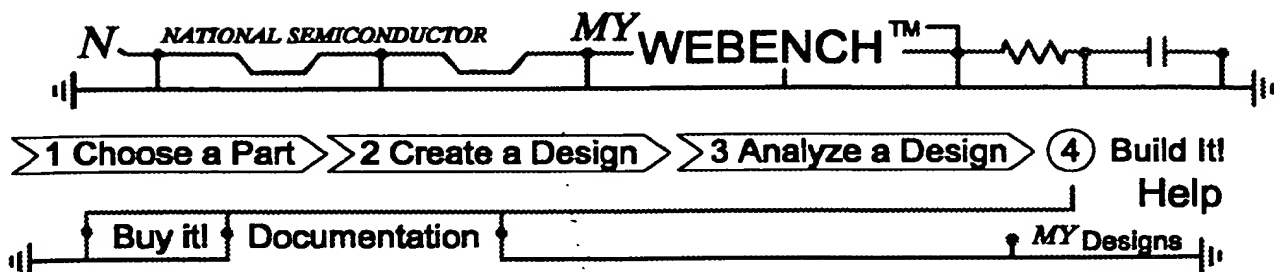
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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Design : 6

## WEBENCH Documentation

### Assembly Doc.

The Webench Assembly Document describes in detail how to build your design. It contains the specific assembly diagram for your design, a complete bill of materials and other PC board images and assembly instructions.

### Design Doc. — 2440

The WEBENCH Design Document provides a single web page describing your entire design including: design specifications, calculated values, WebSIM simulation results and WebTHERM simulation results.

### LM2679 Folder — 2420

LM2679 Product Folder is full of documentation about the National IC used in your design.

### My Orders

My Orders is a list of all of your on - line orders.

## WEBENCH Downloads

You can download these files to integrate this design into your local CAD environment. These files are self-extracting zip files. For the files stored in Protel format you will need the Protel application or equivalent CAD software capable of opening such files.

### Schematic File

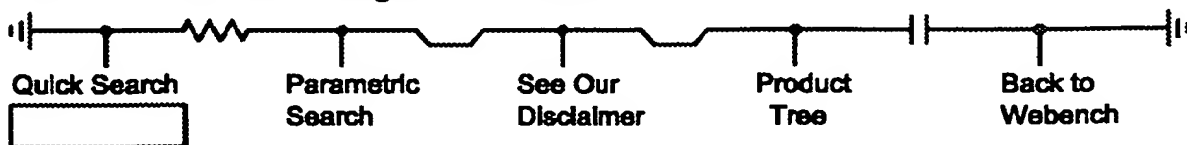
The Schematic File in Protel format.

### Board Layout File

Board Layout In Protel format.

### GERBER File

GERBER file for making the PC Board.



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Figure 23



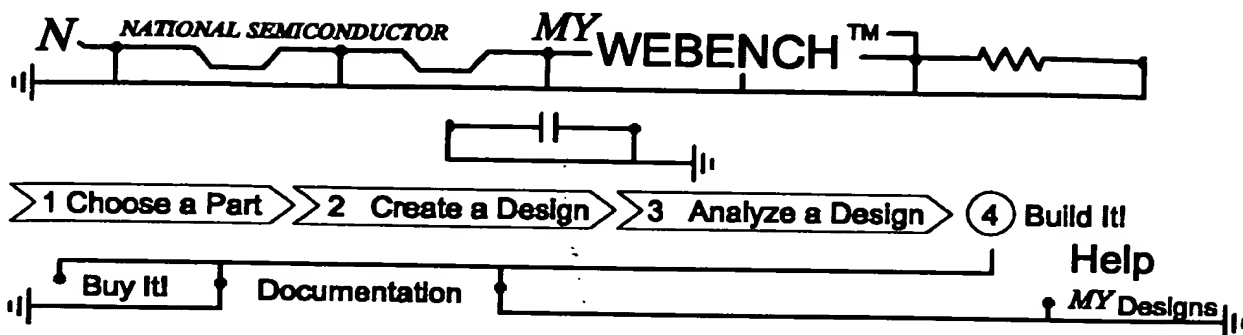
Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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## Design Document For Your LM2679 Design # : 7

### Table of Contents:

1. Introduction
2. Design Specifications
3. Schematic
4. Operating Values
5. The Selected IC
6. BOM - Bill of Materials
7. WebTHERM Results
8. Build It!
9. Appendices

### Introduction

Custom power supply designs using tools are available on the POWER.NATIONAL.COM website.

### Design Specifications

Design: Design #7

Device: LM2679

Mar 17 2001 3 : 39PM

ID: 266796\_7

Design Requirements

Output #1

VinMin = 20.00 V

Vout = 5.00 V

VinMax = 22.00 V

Iout = 5.00 A

### Schematic

Use WebSIM to display your schematic.

### Operating Values

Figure 24A

**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884



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Operating Values			
#	Description	Parameter	Value
1	Pulse Width Modulation (PWM) Frequency	Frequency	260 kHz
2	Continuous or Discontinuous Conduction Mode, inductor current goes to zero in Discontinuous Conduction	Mode	Cont
3	Total Output Power	Pout	25.0 W

Operating Point at Vin = 22.00 V			
#	Description	Parameter	Value
1	Bode Plot Crossover Frequency, indication of bandwidth of supply	Cross Freq	97.7 kHz
2	Steady State PWM Duty Cycle, range limits from 0 to 100	Duty Cycle	25.8 %
3	Steady State Efficiency	Efficiency	85.3 %
4	IC Junction Temperature	IC TJ	120 °C
5	IC Junction to Ambient Thermal Resistance	ICThetaJA	34.9 °C/W
6	Bode Plot Phase Margin	Phase Marg	71.0 Deg
7	Peak-to-peak ripple voltage	Vout p-p	0.07 V

Current Analysis			
#	Description	Parameter	Value
1	Input Capacitor RMS ripple current	Cin IRMS	2.2 A
2	Output Capacitor RMS ripple current	Cout IRMS	0.20 A
3	Peak Current in IC for Steady State Operating Point	IC Ipk	5.5 A
4	ICs Maximum rated peak current	IC Ipk Max	7.4 A
5	Average input current	Iin Avg	2.3 A
6	Inductor ripple current, peak-to-peak Value	L Ipp	1.1 A

**Figure 24B**



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

Docket No. 50019.44US01/PO4884

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<b>Power Dissipation Analysis</b>			
#	Description	Parameter	Value
1	Input Capacitor Power Dissipation	Cin Pd	0.43 W
2	Output Capacitor Power Dissipation	Cout Pd	0.0026 W
3	Diode Power Dissipation	Diode Pd	1.9 W
4	IC Power Dissipation	IC Pd	1.4 W
5	Inductor Power Dissipation	L Pd	0.50 W






**LM2679 The Selected IC**

NSID = LM2679S-ADJ

Topology = Buck

Package = S

**BOM - Bill of Materials**

Item	Manufacturer Part	Qty	Attributes	Component Name(s)
1	International Rectifier 12CWQ04FN 	1	VFatio = 0.52 V	D1
2	Keystone 5015	4		TP1, TP2, TP3, TP6
3	National Semiconductor 551011367-011	1	Surface Mount, etc	PC Board
4	Vishay-Sprague 594D156X0035D2T 	3	Cap=15uF ESR= 0.265 Ohms	Cin
5	Vishay-Sprague 594D187X0016R2T 	1	Cap=180uF ESR= 0.065 Ohms	Cout
6	Vishay-Dale CRCW1206- 1001FRT1 	1	Resistance =1000 Ohms	Rfb1
7	Vishay-Dal CRCW1206- 3161FRT1 	1	Resistance =3160 Ohms	Rfb2

**Figure 24C**





**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

Inventors: Jeffrey R. Perry et al.

Application No. 09/846,681

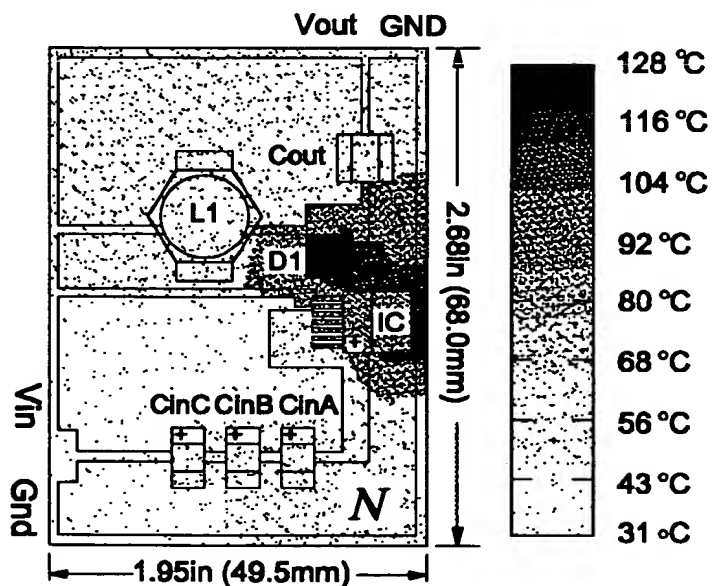
Docket No. 50019.44US01/PO4884

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8	<b>Vishay-Dale</b> <b>CRCW1206-</b> <b>4991FRT1</b> 	1	<b>Resistance = 4990 Ohm</b>	<b>Rilim</b>
9	<b>National</b> <b>Semiconductor</b> <b>LM2679S-ADJ</b>	1	<b>Package=S,</b> <b>Voltage option = ADJ</b> <b>Topology = Buck</b>	<b>IC</b>
10	<b>Coiltronics</b> <b>UP4B-150</b> 	1	<b>L = 15uH</b> <b>DCR = 0.02 Ohm</b>	<b>L1</b>
11	<b>Vishay-Vitramon</b> <b>VJ1206A392JXAAT</b>	1	<b>Cap = 0.0039 uF</b>	<b>Css</b>
12	<b>Vishay-Vitramon</b> <b>VJ1206Y103KXAAT</b>	1	<b>Cap = 0.01 uF</b>	<b>Cb</b>
13	<b>Vishay-Vitramon</b> <b>VJ1206Y104KXAAT</b>	1		<b>Cinx</b>

**WebTHERM - Thermal Simulation Results**

You have performed 3 WebTHERM thermal simulation(s) on this design.  
Here are the results of the most recent one.



**Figure 24D**



**Title: METHOD TO PERFORM THERMAL SIMULATION  
OF AN ELECTRONIC CIRCUIT ON A NETWORK**

**Inventors: Jeffrey R. Perry et al.**

**Application No. 09/846,681**

**Docket No. 50019.44US01/PO4884**

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**Be sure to electrically simulate this design using webSIM.**

---

**Build It!**

Webench provides both custom and generic evaluation boards to assist you in the building of prototypes of your design. Additionally, for some designs, it is possible to order the complete BOM (Bill of Materials) on-line using Webench.

**A custom evaluation board is available for your design!**

Webench provides a custom evaluation board which may be on-line ordered from Pioneer-Standard for designs like yours using National LM2679S-ADJ configured in the Buck topology.

---

**Appendices**

**A. You have performed 3 thermal simulation(s) on this design.**

<b>ID</b>	<b>Simulation Name</b>	<b>Date</b>
1	<u>Simulation for Design 7</u>	Mar 17 2001 5 : 10 PM
2	<u>Simulation for Design 7</u>	Mar 17 2001 5 : 19 PM
3	<u>Simulation for Design 7</u>	Mar 17 2001 5 : 23 PM

**B. No electrical simulation(s) performed on this design.**



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**Figure 24E**

